What is LFAS?

Military Low Frequency Active Sonar (LFAS) has been under development for years and is reported in 2002 to have been tested about 25 times over 7,500 hours around the world with an estimated investment towards deployment at over $350 million. The Navy claims active sonar is needed to defeat recent technological advances such as anechoic coatings and quiet propellers being added to modern submarines that make sound detection more difficult.

The primary purpose of LFAS is to find and track diesel electric submarines, especially ones operating in naturally noisy shallow waters, which coincidentally is where most marine-life resides. Because diesel electric subs use electric motors when underwater this makes them very quiet, even more so than nuclear subs with pumps and reactor noises. Yet in order to find very quiet diesel electric subs in noisy waters the active sonar sound volume has increased to record levels to the extent that it may be adversely affecting the behavior of sound-dependent marine life, and even causing their deaths.

But first, here are some specifications on this military system. The T-AGOS ships are manned by civilian technicians on board, towing the UQQ-2 SURTASS at slow speeds, around 3 knots, which has active and passive components. Yet it's the active side that is of most concern because it operates at 100-1000 Hz due to the fact that sounds in this range can travel great distances, which is why whales utilize the same frequency ranges. The Navy has planned to use four SURTASS operating ships with only two at sea at any given moment. The SURTASS is described as being a 2,600 foot tube like structure encasing numerous hydrophones all attached to a 6000 foot towing cable designed to run at a depth of around 500-1,500 feet. Data is sent via satellite to shore to be processed. SURTASS operations are based in Norfolk Virginia, but other ports include Glasgow, Scotland; Rota, Spain; Yokohama, Japan; Pearl Harbor, Hawaii; and Port Huneme, California. Oddly enough, although the Navy claims it will not use LFAS in shallow coastal waters, presumably for environmental reasons, the active SURTASS system is specifically designed to cut through the clutter and noise there. Indeed that's the main selling

point. The Navy is either being disingenuous or perhaps they mean to float offshore and just crank up the volume to compensate.

The pervasive diesel sub threat propounded by the Navy seems unlikely. Although they are stealthy when using electric power underwater they must surface to run very loud diesel generators in order to recharge their batteries. Because of this they have limited range and endurance largely because, unlike nuclear subs, they need to be refueled with diesel frequently. This relegates them to tactical coastal patrol activities rather than the globe circling strategic missions done by the US Navy, which incidentally has no diesel electric subs at all. This tactical role suits most countries like Iran or China fine, but the threat they pose to American forces is really rather limited and remains defensive in nature. Basically the fear is the unlikely possibility of a stealthy rogue sub sneaking up on an American carrier battle group patrolling foreign waters. Yet the remote possibility of an unthinkable loss was enough for the Navy to initiate yet another sonar project and a major legal and environmental imbroglio.

The LFAS system sets records as the loudest man-made noise underwater besides undersea explosions. Estimated LFAS volumes run anywhere from 120 to 240 decibels. The Navy claims that the sonar sound field around the transmitting ship will be 180 dB out to 1 km and 150-160 dB up to 160 km away. By comparison the noise level next to a jet engine is around 120 dB. But here we need some brief clarification. The decibel system is on a logarithmic scale, so for example 240 dB is one billion times greater in volume than 140 dB. Second, comparing sound in air to underwater levels is not an exact match, one report calculated that 61.5 dB must be subtracted from a sound level in water to yield and an equivalent intensity in air. Third, sounds travel much farther and faster in water than in air, especially under certain circumstances, such as within disparate temperature zones because these ducts act as wave guides channeling sounds great distances.

High Volume Harm

After nearly completing testing on LFA sonar the Navy was preparing to finish up and prepare for full development when environmental groups started making the connection between collocated Navy tests and disturbed whale behavior, such as strandings and beachings. These groups threatened a lawsuit in 1995 to force the Navy to prepare an environmental impact statement (EIS) as required by law. The Navy, facing a messy court battle, opted to write the report, their first ever for new technology, and shelled out several million dollars to hire researchers to study the effects of high powered sonar on marine life. And that's when things started going wrong...

According to a Navy document, after being exposed to 160 decibels of LFAS for 15 minutes, a Navy diver suffered dizziness, confusion, and tingling in the arms. Months later, the diver complained of ongoing memory loss, depression, and seizures. In 1998, eco-tour guide Chris Reid experienced similar symptoms, both short and long term, after being exposed to 125 decibels during LFAS testing in Hawaii. [3]

During trials conducted across the globe stories of beached whales made headlines and soon even the mainstream media began to question connections between LFA sonar testing being

done by the Navy, even though they were reportedly conducted at less than 140 decibels. It's claimed that there have been nine major mass strandings of whales in the vicinity of naval operations since 1975. Some well documented ones include the March 2000 stranding of 16 whales, mainly beaked whales, but including four different species which occurred off Abaco Island in the Bahamas. Necropsies revealed blood in the eyes, brains and damage to the lungs.

In 1991, Simmonds and Lopez-Jurado reported incidents, involving Cuvier's, Gervais' and other beaked whales, on the coasts of Fuerteventura, and neighbouring Canary Islands. Military manoeuvres were observed at sea, close to the stranding sites. [LFAS 2001 WDCS]

March 4 [1998] (Reuters) - Greek scientists said on Wednesday that NATO tests of an underwater sonar system could have caused a mass stranding of whales off the coast of Greece. Twelve Cuvier beaked whales, a deep diving breed that is rarely stranded, washed up on the west coast of Greece in May 1996 just days after the North Atlantic Treaty Organisation tested a Low Frequency Active Sonar (LFAS) system used to detect diesel and nuclear submarines.
The latest stranding was also odd because the animals were not stranded together, but over a 40 kilometre (25 mile) area. Deep diving whales also seem especially affected by low-frequency sounds, even at low levels. [2]

Besides hearing damage it is equally plausible that resonance effects are causing internal ruptures leading to deaths and sinking instead of beaching which poses serious questions as to the full extent of marine life being killed by high-powered noise.

All of these strandings sound very serious but the Navy can still claim that the evidence is circumstantial. And this highlights the fundamental complexity of the issue which is the primary lack of knowledge of the behavior patterns of cetaceans and other marine life. Research is expensive and it's difficult to find and track whales, especially given the vastness of the ocean. It's almost pathetic how little scientists know about many whales species.

Speaking as a scientist who has studied whales for almost 20 years," says Weilgart, "I'm not confident we can accurately define what goes on ... with nursing, mating, and feeding [in the absence of LFAS]. The humpback whale, for example, has been studied to death, and we have never once observed mating." If normal behavior is not understood and rarely observed, she says, it is impossible to know what sort of observable behavior is abnormal or indicates harm. - Mother Jones News

The 50-ton sperm whales are being used instead of other underwater mammals because the research will help scientists better understand the elusive mammals. Sperm whales dive thousands of feet deep to feed, presumably on giant squid, and there's little research on how their clicking is used to find prey. - National Geographic News

Knowing so little about whales, the critical process of determining what's normal and what isn't becomes very challenging. Yet this is the primary tool used for deciding if LFAS is affecting marine life. If normal, or indeed much of any behavior patterns aren't understood, then what good is any of this? Environmental groups can point out whales leaving the area of the sonar

tests and autopsies can highlight trauma to beached whales but the Navy can still claim that none of this is directly caused by LFAS.

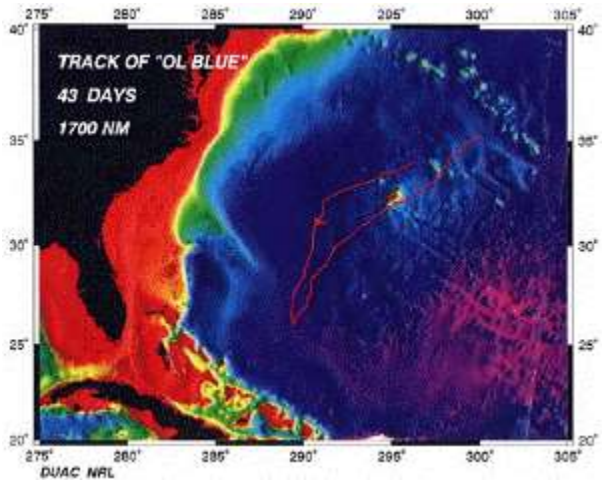
It's known that sound is important to sea-life and is used to feed, mate, navigate, detect predators, and communicate. The blue whale is even thought to be able to communicate over ocean distances in excess of 1,000 km. One valid observation made by proponents of LFAS is that many whales themselves generate sounds at levels between "170 and 180 dB" or in the midrange of LFAS produced volumes. The sound pressure force is not the same, but even granting LFAS operating at similar volumes and frequency ranges this, at minimum, will create sound competition whales and other sea-life will be forced to compensate for, making hearing and communicating that much more difficult.

Navy research has fixated on hearing damage to cetaceans but this may not be the full extent of the issue. Even worse effects of high intensity sonar likely come from the resonance phenomena in the whales' cranial air spaces, destroying delicate brain and ear tissue. The necropsies done on the stranded whales in the Bahamas of March 2000 showed this to be the cause of death. Not just whales but all animals, including humans, with air filled lungs and swim bladders are vulnerable to undersea sound and shock waves due to the difference in impedance between air in the lungs and their body tissues or sea water. Submerged animals exposed to explosions at short range have shown lung hemorrhaging and ulceration of the gastro-intestinal tract. This may explain why deep diving whales like beaked whales seem more prone to damages, probably due to concussion pressures on them, the swim bladder, or in this case the lungs.

The US Navy is not alone on LFAS, other countries have, or will soon deploy, systems of their own. Britain has one for type 23 frigates called Sonar 2087, developed by Thomson Marconi. All of these advanced modern sound detection systems require significant computing power to electronically extract signal from noise. Yet the military and computers have a rocky history, especially when it comes to weapons systems. Every defense procurement must go through a prolonged process, trials, contract establishment and often multiple companies building components for a single custom designed system ordered for a specific task. This process always results in overpriced and under-powered computers because, as consumers know, computing power increases by the month while the price goes down. So the military will take 5 years to get a computer that ends up costing 10 times as much as an off the shelf system with a fraction of the processor power. Even a cursory overview of recent sonar and computer systems the Navy has developed or attempted to develop show chronic and serious problems, everything from cost overruns to systems that turn out to be too big to fit on the sub! Example, the BSY-1 system for the SSN 688 class subs.

Furthermore I believe this is the case with LFAS. The Navy is using 10 to 20 year old technology to solve present day problems. Off the shelf will beat contract designed computers every time. After that the military needs only to work on integration and software compatibility. With present day computing power it's likely that now, or very soon, it will be possible to process signal from noise using a passive system to achieve equal, if not better, results instead of using ear-shattering and location-revealing active sonar. Utilizing passive listening systems instead of active provides many benefits. The location of the emitter will not be disclosed, making naval employment less dangerous and operations stealthier, plus it's environmentally

safe. I don't know of any technical reason LFAS must be employed instead of passive systems except perhaps the greater computing power needed to rapidly find the signal in the noise, in this case a diesel electric boat. Another means to minimize the harm to marine life would be altering the frequency range to one that is beyond the detection of whales, albeit at the cost of maximized distance propagation. The point is that technological solutions exist, if the willingness is there to pursue them.



One example of the benefits of passive listening systems comes from SOSUS. With the demise of the cold war and declining military activity the SOound SUrveillance System (SOSUS) was opened up to civilian research. SOSUS consists of strings of hydrophones laid across the sea floor at strategic positions across the globe, such as across the straits of Gibraltar and the North Cape off Norway. They're linked to command centers on shore and are highly sensitive passive sensors operating at low-frequency sounds (<1000 Hz). Different whales can be tracked at varying distances, for example the blue and fin whales can sometimes be detected by SOSUS at distances greater than 1500 nautical miles. In one case a blue whale was tracked across the ocean for 43 days. Interestingly enough SOSUS is being phased out by the Navy to be replaced by LFAS! LFAS may well render SOSUS useless anyway seeing as how they use the same frequency range so the SOSUS passive listening could be blasted out by the LFAS sound volume.

For sea life that relies on hearing to survive, LFAS is not the only affront to aural tranquility. Other loud, damaging noise come from petroleum exploration and a global warming research program known as ATOC or Acoustic Thermometry of Ocean Climate. This program costs at least $43 million and is funded by the Department of Defense. Scripps Institute of Oceanography runs it in a complicated effort to measure water temperatures by blasting very loud sounds through an efficient conductor known as the deep sound channel, starting on one side of an ocean basin and measuring the time it takes for the sounds to arrive at the other side. Since sound travels faster in warm water than in cold, average temperatures for whole ocean basins can be measured.

Petroleum exploration utilizes various methods to locate oil deposits under the seabed to include air guns which emit a bubble that bursts creating immense sound shock waves over 250 decibels that bounce off the sea floor up to 30,000 feet below the surface and return to the surface recording the sub surface structure. Any whales within range will be immediately deafened, perhaps permanently which would doom them to death if not killed outright through concussion or similar physical damage from the resonance effects of the shock. The oil companies involved could switch to quieter sonar systems but like always the cost would be greater, and as of yet they seem to feel no need to be environmentally conscious except in advertising.

The point is that no one makes an attempt to limit the sounds underwater or add quieting technology, like a car needs a muffler. And the Navy is likely the least environmentally conscious of the military branches largely because they operate over water where the 'out of sight out of mind' mentality rules. Not just the Navy but all marine traffic is implicated in garbage dumping, oil slicks, pollution of every sort -- anything goes and almost anything does on the high seas because the distance from population centers, vastness of oceans and the international legal vagaries that leave little national oversight or property ownership to compel responsible behavior.

Currently LFAS approval is at a final stage with the National Marine Fisheries Service (NMFS) in Maryland which holds the ultimate decision-making authority. With all the things that have gone wrong for the Navy recently, the loss of an EP-3 surveillance plane to China along with top secret information, the submarine caused sinking of a Japanese fishing boat along with a few school kids, not to mention the ongoing confrontation between the Navy and Puerto Ricans over the Vieques bombing range, one would think they'd wish to avoid another public relations fiasco. Alas this does not seem to be the case. So far the Navy continues to support LFAS, and given all the complexities, lack of research on marine life, the circumstantial nature of the opposing evidence, and the significant investment the Navy has already put into the program I would guess that NMFS will approve the program. But if they do the legal challenge is already waiting, and the saga continues.

Updates

The latest research in 2011 indicates that loud underwater noises, primarily caused by humans, are not just responsible for causing the deaths of whales and dolphins, but can lead to the death of a wide range of sea life. Engine sounds from shipping, sonar pings and explosions used to prospect for oil and gas, all cause intense harm to underwater life. Squid, cuttlefish and octopuses are quickly rendered permanently unable to move when exposed to loud sounds because the organ they use to navigate is ruined.

"For the first time we are seeing the effects of noise pollution on species that apparently have no use for sound," says Michel André of the Technical University of Catalonia in Barcelona, Spain. "We were shocked by the magnitude of the trauma," he says.

The results of the experiments, in which André's team exposed captive cuttlefish, octopuses and squid to low-frequency sound for 2 hours, seem to confirm that "ear" damage in nine giant squid that unexpectedly washed up on Spanish beaches in 2001 and 2003 was caused by low-frequency sounds from nearby seismic surveys for oil and gas. [...]

Squid, octopuses and cuttlefish were exposed to sweeps of low-frequency noise ranging from 50 to 400 hertz – an "acoustic smog" similar to that created by oil and gas exploration, and shipping.

Post-mortems showed that the linings of statocysts from cephalopods not exposed to sound retained the fine hairs that sway as the animals move through water, and are essential to the animals' balance and orientation.

Statocysts from the exposed animals, by contrast, had lost huge patches of hair, leaving holes in the membranes of the organ's cells. The insides of the cells had pushed their way through the holes, and mitochondria – the power plants of cells – had suffered extensive damage. [1]

1. Shipping noise pulps 'ears' of squid and octopuses, by Andy Coghlan, New Scientist, 11 April, 2011.

News

- Beaked whales affected by Navy sonar in test, BBC, 14.03.11
- Navy plans threaten more marine mammals, USA Today, 05.08.10
- US military uses marine mammals for war purposes, The Virginian-Pilot, 10.06.10
- Seismic tests found to impact whale calls, BBC, 23.09.09
- Navy sonar may threaten whale birthing area, MSNBC, 14.03.09
- *(British) Navy in live firing before dolphin stranding deaths*, BreakingNews Ireland, 10.06.08
- *Navy sonar blamed for death of beaked whales*, The Independent (UK), 04.07.08
- Bush overrides law, exempts Navy from sonar ruling, Seattle Post-Intelligencer 16.01.08
- *US judge limits marine military sonar in California*, AFP 03.01.08
- Navy may gain free use of high power sonar, protections removed, Honolulu Star Bulletin 26.07.07
- Navy uses secrets law to continue use of sonar, MSNBC 21.03.07
- Navy gets exemption to continue use of high-power sonar, MSNBC 24.01.07
- *'Whale Vocab Richer Than Thought'*, but threatened by artificial noise, Discover news 17.11.06
- Use of high powered Navy sonar near Hawaii blocked temporarily, BBC 04.07.06
- Is Navy sonar to blame for 400 dead dolphins on African beach?, MSNBC 29.04.06
- *'Group Sues Navy to Limit Sonar It Says Harms Marine Life'*, Washington Post 20.10.05
- *'Chemical may cause whale hearing loss'*, MSNBC 28.01.05
- *'Seismic surveys may kill giant squid'*, New Scientist 22.09.04
- *'Dead whales found after military exercises'*, MSNBC 23.07.04
- Artificial undersea noise found to be harmful to sea life, BBC 22.07.04
- *'Animal welfare groups threaten to sue US navy on harm to whales'*, AFP 15.07.04
- Hawaii: *'New focus on sonar and whales'*, MSNBC 12.07.04

- *Alarm sirens lure whales into peril*, New Scientist 03.12.03
- *Navy agrees to limit use of sonar*, MSNBC 13.10.03
- *Navy sonar on hold in whale lawsuit*, MSNBC 01.11.02
- *Navy [explosives] training killing fish in Puget Sound*, The Oregonian 09/29/02
- *Navy sued over new sonar system*, MSNBC August 7, 2002